

Russian Smokejumper Parachute Evaluation:

Lesnik 3

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Background:

In the spring of 2002, Boise Bureau of Land Management (BLM) Smokejumpers hosted representatives of the Russian Aerial Fire Protection Service (Avialesookhrana). The purpose of their visit was to observe and learn the Boise jumpers' methods of rookie training. During this visit we learned of the Russians plans to evaluate a newly developed Lesnik 3 parachute system in the fall of 2002. Bruce Ford of the Alaska Fire Service researched the Russian Smokejumpers' efforts to secure a next generation parachute system during a trip he made to Russia over the winter of 2000-2001. Please reference Bruce's report "New Parachute Technology Being Considered By Avialesookhrana" dated April 10, 2001. Bruce's report details the background information on the development process. Copies provided upon request.

BLM Smokejumpers are presently engaged in an on going process of researching parachute equipment, with an eye toward improving their own system. The BLM and the Forest Service (FS) have also agreed to work together to develop their next generation parachute equipment. The timing was right for observing the Russian evaluation, considering they were completing a process the BLM and the FS were just starting. The International Fire and Aviation Program at the National Interagency Fire Center (NIFC) sponsored George Jackson and myself for the trip to Russia to observe the evaluation of the Lesnik 3 parachute system. Mr. Jackson is a Program Leader at the Forest Service's Missoula Technology and Development Center (MTDC). I am an Equipment Development Specialist employed by BLM/NIFC and stationed at MTDC.

The Lesnik 3 is manufactured by NPP Zvezda and was called the Arbalet during its testing phase. The production model is called the Lesnik 3. Our trip took place September 7 through September 22, 2002.

My objectives for the trip were to:

1. Learn how Avialesookhrana structure their evaluation plan.
2. Examine and understand how the Lesnik 3 system functions.
3. Learn the flight characteristics of the new canopy.
4. Determine if American Smokejumpers can adopt any of their procedures or equipment ideas.

Evaluation:

Andrey Eritsov, Equipment Specialist and Smokejumper with Avialesookhrana, served as our interpreter, advisor and primary contact while we were in Russia. Andrey is stationed at the central base in Pushkino, just outside Moscow. The actual evaluation program was carried out at the regional airbase in Vladimir City about 100 miles east of Moscow. Lead parachute instructors from regional airbases around Russia were on the evaluation team, as well as representatives from the Ministry of Emergency Management (Emercom, or Emergency Committee). Sergei Kalubhokov, of NPP Zvezda parachute manufacturing and the designer of the Lesnik 3, also took part in various aspects of the evaluation.

Emercom employees are sent all over Russia to provide aid in the event of disasters such as floods, earthquakes, airplane crashes, terrorist bombings, etc. They will travel to help in foreign countries, if invited. The para cargo/aerial search and rescue department of Emercom wants to use the same canopies as the Smokejumpers and was there on an interagency basis to help evaluate the Lesnik 3 parachute. Emercom's harness/container system is noteworthy in that it is a modern free fall rig, with a detachable cargo container that can be air dropped via a static line attached to the jumper's harness. It looks very simple and effective.

I enjoyed being around this group of people (Photo 1). They were experienced, competent and professional. They worked well together and freely exchanged information and ideas.



Photo 1

I received a copy of the evaluation plan, which is being translated. When the translation is complete, copies will be available. The following is a very general summary of that plan.

Avialesookhrana is interested in having all of their Smokejumpers use one system. Their present ram air system, the Lesnik 2, has weight limitations that force heavier jumpers to use their round parachute system. Likewise, the new and inexperienced jumpers must use the round system, as the Smokejumpers feel the Lesnik 2 parachute canopy is too advanced for rookies and inexperienced jumpers. Another major concern with the Lesnik 2 is that it uses a non-steerable round reserve. In the event of a cut away malfunction, they want a reserve that will allow the

jumper to get back and land in the jump spot. Ten parachute assemblies (rigs) were built for the evaluation.

The evaluation plan also addresses their desire to utilize a better protective jump suit. The current suits are hot and the jumpers feel the suit doesn't provide adequate protection for landing in rough terrain. The remainder of the plan lists testing goals, the equipment to be tested, type and number of tests, testing conditions and procedures, means and parameters of measurement, and testing methods.

The evaluation started with inspections of the equipment and static demonstrations of various procedures that would need to be implemented. A new letdown procedure was developed because of differences in harness configuration from the new gear and that of the current system. A new jump helmet and let down friction device were also evaluated, as the manufacturers of the old ones had gone out of business. Both of these items were similar to their existing models. The jumpers also looked at a new tree climbing harness built by one of the jumpers. They did some climbing with it, even though this piece of equipment was not part of the parachute evaluation. Because they seldom get a chance to get together, they used this opportunity to have a general technicians meeting.



Photo 2

New climbing harness and jump helmet¹

¹ The Russians don't jump with Personal Gear bags or hard hats. They wear their jump helmets for tree climbing.

The next phase of the evaluation plan called for dummy drops to document drogue in tow malfunction with a successful reserve deployment. The Lesnik 3 had been thoroughly tested by the factory and had also passed all necessary military testing² prior to this evaluation program. Avialesookhrana wanted documentation on hand for this dummy drop, so they duplicated some tests to get video documentation for their records. Dummy drops were also made to determine the feasibility of using what they called “static line” deployment from the An2 aircraft.

The “static line” deployment of the Lesnik 3 basically amounts to not hooking up the drogue to the release device. Some additional rigging is required to insure a properly staged deployment. The parachute simply deploys, starting upon exit, without the drogue stabilization delay period. American skydiving instructors have used this method and refer to it as pilot chute assist static line.



Photo 3

Float test for new jump suit

² The other parachute company whose design was once also considered (Paraavis) did not choose to under go the military testing, thus eliminating them from consideration. Parachute equipment used by government employees must pass military tests.

The evaluation jump plan was designed to document and quantify performance characteristics of the Lesnik 3 canopy. Each jump had a specific parameter to be measured and the jumper was briefed prior to each jump as to what he was to do or measure. Measurements taken included turn rate, rate of descent for given toggle settings, front riser dive mechanism effectiveness, time needed to develop stall and altitude loss associated with these maneuvers³. The jumping started at the Vladimir City airport, which provided a large, obstruction free landing area. Wind conditions varied from no wind to 15 miles per hour plus. As data and experience were gathered, smaller forested jump spots were chosen to simulate fire jump conditions. Water jumps were performed after we returned to America.

Aircraft used included the Antonov (An) 2, a ten-jumper bi-plane with a single radial engine. This aircraft featured a side door; stand up exit with an exit speed of about 100 mph. (Photo 4). The Antonov (An) 26 was also evaluated. The An26 was a fairly large, high wing twin turbine airplane equipped with a rear ramp for walk off exits. The An26 held 30 jumpers and equipment. Exit speed for the An 26 was 160 mph (Photo5). An Mi8 helicopter was also to be part of the jump evaluations, but they were all busy fighting fires in other regions of Russia at the time of our visit.



Photo 4

An2

³ A more complete and detailed list will be available upon completion of the evaluation plan translation.



Photo 5

An26

Equipment

Jump Suit

The new jump suit design incorporates some features from American Smokejumper suits and the US military rough terrain suits. It is a one-piece design, with high brush collar, crotch protection strap and foam padding located in strategic areas. No hard pads are used. Small pouches are sewn to the front of the thigh area, the right leg pouch to be used to carry the let down rope. The jump suit material appears to be a synthetic cotton blend that has been treated with a flame resistant chemical.

Harness/Container

Conventional piggyback systems place the main container on the bottom and the reserve on the top. The Lesnik 3 locates the main on top and the reserve on the bottom. They do that so the drogue and drogue release can be located on top of the main container and not pass over or interfere with the reserve container. The drogue d-bag is stowed on top of the main container with an elastic bungee. The main and reserve containers, along with the reserve risers, are a non-separable, integral part of the harness. Four metal rings are built into the front of the harness to accept an optional cargo container.

Only one size rig is available and it is adjustable to fit virtually any body size or shape. The adjustment buckles are located on the main lift webs, central back strap, back diagonals and lower back straps. While this may complicate construction, it eliminates the need to carry excess inventory dictated by sizing requirements. An added benefit to the jumper is that they do not have to “live with it” if they happen to be in between sizes or if the jump suit style changes. The adjustments allow fine-tuning so everyone can get a perfect custom fit, with or without the jump suit.

The materials and hardware of the harness/container system are all appropriate to the size, type and strength required for standard safety margins. Likewise, the construction techniques and stitch patterns are appropriate for the application. Some of the materials are American made and imported. Other materials are manufactured in Russia.

The drogue release handle is located facing in-board on the left side of the main lift web. The Automatic Activation Device (AAD) unit is mounted on the lower right side by the reserve container and the drogue release mechanism is built in to the top of the main container/harness assembly. The Reserve handle is combined with the main release handle and is mounted facing in-board on the right side main lift web



Photo 6



Photo 7

By pulling the reserve handle “x” amount of distance, the main canopy release takes place. The main canopy attachment is via standard Three Ring Release assemblies. By pulling the same handle an additional “y” distance, the single reserve pin is pulled, allowing the spring loaded pilot chute to deploy and start the reserve canopy deployment. Some student parachute equipment in the United States employ this single handle idea for cutting away the main and deploying the reserve. There is an over ride feature (a snap with a small handle) that allows releasing the main canopy without activating the reserve. This feature is included to allow detaching the main without activating the reserve in the event of a high wind landing or when doing a let down from a tree landing. (Photo 8, next page)



Photo 8

Reserve handle (silver metal) and Main release handle (orange plastic)

Main canopy deployment starts with a drogue static lined from the aircraft. The static line is very short, allowing the drogue to open very soon after the jumper exits. The drogue is attached to the top of the harness by a mechanical release device (Photo 9). A four second drogue fall takes place, stabilizing the jumper for a smooth main canopy deployment. The drogue is then released either by the jumper pulling the drogue release handle, or by the firing of the AAD. The AAD starts its four-second cycle automatically by the deploying drogue. The drogue then becomes a pilot chute and pulls a single pin, which opens the main container. The drogue, turned pilot chute, provides the necessary drag to complete the main canopy deployment.



Photo 9

Drogue release mechanism

Canopies

The main and the reserve canopies are nearly identical; the only difference is that the reserve has longer suspension lines. The longer lines allow the reserve to better clear the top of the drogue and inflate in cleaner air in the event of a drogue in tow malfunction. A major advantage of having the same canopy for the reserve is the jumper is familiar with the handling characteristics.

The Lesnik 3 canopy is a nine cell, high aspect ratio wing of approximately 290 square feet. The plan form is not a perfect rectangle (Figure 1). The center 3 cells are approximately 6 to 10 inches longer than the out board cells. I don't know if the airfoil shape of the three center cells is different from the out board cells. Further inspection, with measurements, will give us more information. The cascaded steering lines are attached in four locations (the two end cells on each side). The longer center 3 cells have no steering line attachments. These "extended" center cells seem to contribute to keeping the canopy flying in deep brakes, delaying the onset of a stall. I suspect rib shape and line trim also influence the stall characteristics.

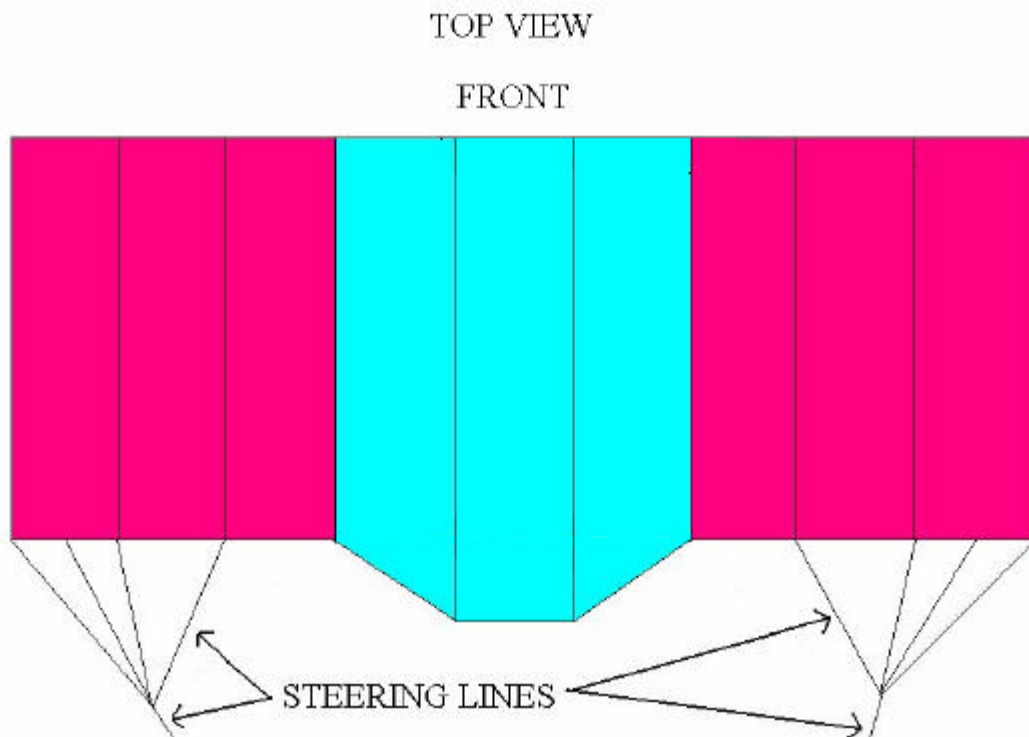


Figure 1
Lesnik 3 Main and Reserve Canopy Plan Form
(Not to scale)

Upon reaching the stall point toggle setting, the Lesnik 3 takes about 8 seconds to stall. This is a fairly long time period for ram air parachutes in general. While in the deep brake setting the canopy gradually slows in forward speed and increases in descent rate. The long period of stall development is an intentionally designed flight characteristic.

The slow or long stall break is felt to be desirable by the Russian smokejumpers for training students and for keeping less experienced jumpers from stalling in to the ground, which can result in unacceptably hard landings. If the jumper miss-times the landing flare (flares too high off the ground), the canopy will keep flying for a long time. The theory is that the jumper will probably land safely before the canopy stalls⁴.

The Lesnik 3 has a full run speed of about 20 mph. The short rib height reduces frontal drag, which results in great wind penetration. The initial evaluation jumps were conducted in wind speeds of about 12 to 15 mph. Even the lightest jumpers had significant forward speed at full run. Landings in windy conditions are very soft with an appropriate flare.

No wind landings are interesting in that the canopy does not rotate as much as would be expected with a high aspect ratio nine-cell canopy. The center cells don't get pulled down like the rest of the trailing edge when landing brakes are applied. The combination of the center cells wanting to keep flying and their lack of extra lift contribution make for more forward speed on landing. Even with the small amount of forward speed, landings are very soft and totally acceptable.



Photo 10

⁴ Stall recovery time and altitude seem normal for a nine-cell design.

Conclusion:

The evaluation of the Lesnik 3 parachute system was conducted in a professional, thorough manner. The experience of the group was evident when new procedures had to be developed to accommodate the differences between the current Lesnik 2 and the new proposed system. The performance measurements obtained will allow the Smokejumpers to further develop training and procedures, should they decide to go ahead with this system.

Initial comments of the evaluation indicate the Smokejumpers were very happy with the Lesnik 3. Avialesookhrana is now preparing a final evaluation report and no implementation decisions have been made yet.

I like the harness/container system for several reasons. Placing both parachutes on the jumper's back has some advantages. Comfort and range of motion are better than with a chest-mounted reserve. I believe better range of motion makes it easier to get good body position on exit. The jumper's hands are also more likely to be out of the way of a deploying reserve, reducing the likelihood of interference or entanglement. Padding designed to protect the jumper's front can be employed in the jump suit construction, rather than relying on the reserve for landing impact protection.

I think a one-piece harness/container system has an advantage because the jumper can simply don one piece of equipment and be ready to go. BLM's current system requires donning three pieces of equipment, which then must be connected while suiting up. I especially like having the reserve (emergency) system constructed in one single piece. The main canopy can easily be left attached to the harness, making checking and rigging less time consuming.

The drogue for the Lesnik 3 is smaller than the BLM drogue. The smaller size may contribute to its smooth, stable ride. Replacing the old drogue suspension lines with "vaness" attached to a central bridle reduces the possibility of drogue suspension line entanglements.

The drogue release device is a well-made piece of hardware, as is the AAD drogue release back up. The Russian jumpers have a great deal of faith in these two pieces of equipment. An AAD is a wise investment for any parachute assembly.

Steep, deep brake approaches over tall trees may be difficult for the Lesnik 3. American Smokejumpers often encounter this scenario and need a parachute that flies and lands well in deep brakes. High aspect ratio nine cell canopies such as the Lesnik 3 typically require long shallow approach paths prior to landing. All in all, the Lesnik 3 canopy is a very nice flying parachute. I believe it will do what the Russian Smokejumpers want it to, for the inexperienced jumpers as well as the experienced.

I would like to express my appreciation and thanks to everyone who supported us and made this trip possible. We've learned a lot and I believe it will help guide us in our own parachute development efforts.

